Sun Ray™ Deployment on Shared Networks

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Sun Ray Deployment on Shared Networks

This article is intended to help network administrators and deployment specialists maximize utilization of existing network infrastructures when they install and configure Sun Ray implementations.

When first introduced, Sun Ray™ desktop units (DTUs) could be deployed only on dedicated, directly-connected interconnect subnets. Although dedicated interconnects provide reliable service and are easy to configure, they require the full-time commitment of networking equipment, cabling, and host interfaces.

Sun Ray Server Software 2.0 removes this constraint and allows network administrators to deploy Sun Ray DTUs nearly anywhere on an enterprise intranet. The most important advantages of intranet deployment are:

- Sun Ray can be deployed on any existing network infrastructure that meets Sun Ray Quality of Service (QoS) requirements.
- Sun Ray DTUs can be deployed at a greater distance from their Sun Ray server than is possible with an unrouted Ethernet interconnect.

This article describes the process of deploying DTUs on shared network segments and covers the following topics:

Sun Ray DTU Initialization Requirements

Because Sun Ray DTUs are stateless, they rely entirely on network services to provide the configuration data they need to complete their initialization.

- Each DTU must first acquire basic network parameters, such as a valid IP address, on the network to which it is connected.
- The DTU can also be supplied with additional configuration information to support advanced product features, such as the ability to update the DTU firmware and to report exception conditions to a syslog service.
- The DTU must locate and contact a Sun Ray server that can offer desktop services to the Sun Ray user.

The Sun Ray DTU uses the Dynamic Host Configuration Protocol (DHCP) to obtain this information.[1]

DHCP Basics

The DTU is a DHCP client that solicits configuration information by broadcasting DHCP packets on the network. The requested information is supplied by one or more DHCP servers in response to the client's solicitations. DHCP service may be provided by a DHCP server process executing on a Sun Ray server, by DHCP server processes executing on other systems, or by some combination of the two. Any conforming implementation of a DHCP service can be used to satisfy the DHCP requirements of the DTU. Sun's Solaris DHCP service is one such implementation. Third-party implementations executing on non-Sun platforms can also be configured to deliver information to Sun Ray DTUs.

The DHCP protocol defines a number of *standard options* that can be used to inform the client of a variety of common network capabilities. DHCP also allows for a number of *vendor-specific options*, which carry information that is meaningful only to individual products.

The Sun Ray DTU depends on a small number of standard options to establish its basic network parameters. It depends on several standard and vendor-specific options to provide the additional information that constitutes a complete DTU configuration. If these additional configuration parameters are not supplied, the DTU cannot perform certain activities, the most important of which is the downloading of new DTU firmware. TABLE 2 lists the vendor-specific options.

1. DHCP is an Internet Engineering Task Force (IETF) protocol described in Requests for Comments (RFC) *RFC 2131* and *RFC 2132*.

Note – If an administrator chooses not to make this additional configuration information available to the Sun Ray DTUs, a procedure must be established to deliver firmware updates to them. One solution would be a small, dedicated interconnect on one Sun Ray server. Then, the administrator can transfer the DTUs one-by-one when new firmware becomes available on the server, for instance, through a patch or Sun Ray product upgrade.

The location of the Sun Ray server is usually conveyed to the DTU through one of a pair of DHCP vendor-specific options, *AuthSrvr* and *AltAuth*.[2]

If the DTU does not receive this information, it uses a broadcast-based discovery mechanism to find a Sun Ray server on its subnet. The DTU firmware first released with patch 114880-01 for Sun Ray Server Software 2.0 goes one step further. If the broadcast-based discovery mechanism fails, the DTU interprets the DHCP standard option (option 49) of the *X Window Display Manager* as a list of Sun Ray server addresses where it attempts to contact Sun Ray services. This can simplify the DHCP configuration of LAN-deployed Sun Rays by removing the need for a DHCP vendor option to carry this information (see TABLE 1).

TABLE 1 DHCP Service Parameters Available

Parameters	Sun Ray Server DHCP Service	External DHCP service with vendor-specific options	External DHCP service without vendor-specific options	No DHCP service
Basic network parameters	Yes	Yes	Yes	No
Additional parameters (for firmware download, etc.)	Yes	Yes	No	No
Sun Ray server location	Yes	Yes	Yes, through broadcast discovery or the *X Display Manager* standard option	Yes, through broadcast discovery

DHCPINFORM

DHCP enables two stages of parameter discovery. The initial `DHCPDISCOVER` stage discovers basic network parameters. This stage may be followed by a `DHCPINFORM`, which finds additional information that was not provided during `DHCPDISCOVER`.

2. See Table 2 on page 22.

All Sun Ray appliances must have access to at least one DHCP service, which provides network parameters in response to a `DHCPDISCOVER` request from the DTU. DTUs containing firmware delivered with Sun Ray Server Software 2.0 can exploit the `DHCPINFORM` feature. They enable full configuration of the DTU, even when an external DHCP service that is not capable of providing complete configuration data provides the network parameters of the DTU.

DTUs that contain pre-2.0 firmware require all of their configuration information in the initial `DHCPDISCOVER` phase. They do not attempt a `DHCPINFORM` step. Such DTUs must be upgraded with Sun Ray Server Software 2.0 firmware before being deployed on a shared subnet, if the deployment strategy requires a two-step DHCP interaction.

DHCP Relay Agent

The DTU sends DHCP requests as broadcast packets that propagate only on the local LAN segment or subnet. If the DTU resides on the same subnet as the DHCP server, the DHCP server can see the broadcast packet and respond with the information the DTU needs. If the DTU resides on a different subnet than the DHCP server, the DTU must depend on a local DHCP Relay Agent to collect the broadcast packet and forward it to the DHCP server. Depending on the physical network topology and DHCP server strategy, the administrator may need to configure a DHCP Relay Agent on each subnetwork to which Sun Ray clients are connected. Many IP routers provide DHCP Relay Agent capability. If a deployment plan requires the use of a DHCP Relay Agent, and the administrator decides to activate this capability on a router, the appropriate instructions can be found in the router documentation, usually under the heading of “DHCP Relay” or “`BOOTP` forwarding.”[3]

In certain cases, an existing enterprise DHCP service provides the DTU with its IP address while a Sun Ray server provides it with firmware version details and Sun Ray server location. If a deployment plan calls for DHCP parameters to be provided to the DTU by multiple servers, and none of those servers is connected to the subnet where the DTU resides, the DHCP Relay Agent should be configured so that the DTUs subnet can deliver broadcasts to all the DHCP servers. For example, in routers controlled by a Cisco IOS Executive, the `ip helper-address` command activates a DHCP Relay Agent. Specifying multiple arguments to the `ip helper-address` command enables relaying to multiple DHCP servers.

3. DHCP is derived from an earlier protocol called BOOTP. Some documentation uses these names interchangeably.

Network Topology Options

There are three basic topology options for Sun Ray deployment. DTUs can be deployed on:

- a directly-connected dedicated interconnect.
- a directly-connected shared subnet.
- a remote shared subnet.

A Sun Ray server can support any combination of these topologies, which are shown in FIGURE 1.

Note – Sun Ray traffic on shared networks is potentially more exposed to an eavesdropper than traffic on a dedicated Sun Ray interconnect would have been. Modern switched network infrastructures are far less susceptible to snooping activity than earlier shared technologies, but to obtain additional security the administrator may choose to activate Sun Ray's encryption and authentication features. These capabilities are discussed in the “Encryption and Authentication” section of the *Sun Ray Server Software Administrator's Guide.*

Directly-Connected Dedicated Interconnect

The *directly-connected dedicated interconnect*—often referred to simply as an interconnect—places DTUs on subnets that are:

- directly connected to the Sun Ray server (that is, the server has a network interface connected to the subnet).
- devoted entirely to carrying Sun Ray traffic. Prior to the release of Sun Ray Server Software 2.0, this was the only officially supported Sun Ray topology.

The Sun Ray server, which guarantees the delivery of the full set of DTU configuration parameters, is always used to provide DHCP service for a dedicated interconnect.

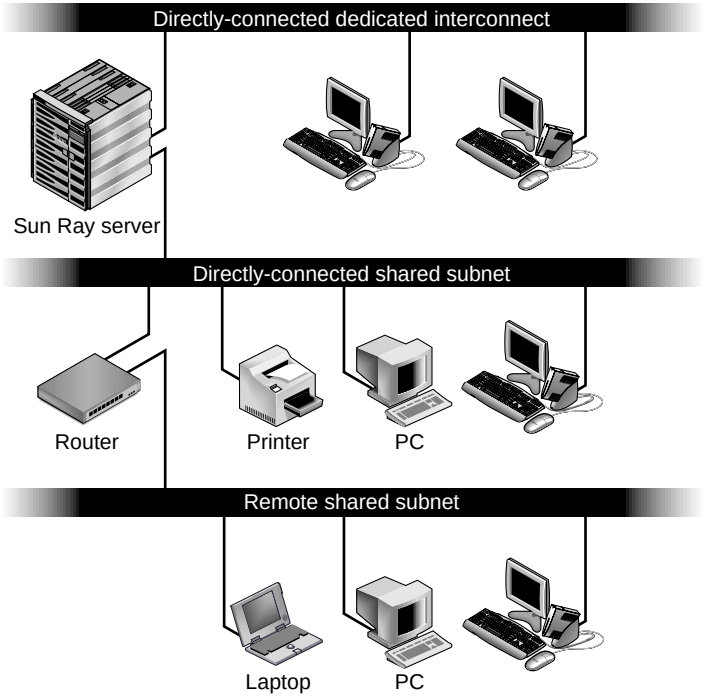

FIGURE 1 Network Topologies for Sun Ray DTU Deployment

Directly-Connected Shared Subnet

Sun Ray Server Software 2.0 introduced official support for DTUs on a *directly-connected shared subnet*, in which:

- the Sun Ray server has a network interface connected to the subnet.
- the subnet may carry a mix of Sun Ray and non-Sun Ray traffic.
- the subnet is generally accessible to the enterprise intranet.

On a directly-connected shared subnet, DHCP service can be provided by the Sun Ray server, or some external server, or both. Since the Sun Ray server can see broadcast DHCP traffic from the DTU, it can participate in DTU initialization without requiring a DHCP Relay Agent.

Remote Shared Subnet

Sun Ray Server Software 2.0 also introduced official support for DTUs on a *remote shared subnet*. On a remote shared subnet:

- a Sun Ray server does not have a network interface connected to the subnet.
- the subnet can carry a mix of Sun Ray and non-Sun Ray traffic.
- all traffic between the server and the DTU flows through at least one router.
- the subnet is generally accessible to the enterprise intranet.

On a remote shared subnet, DHCP service can be provided by the Sun Ray server, by some external server, or by both. For DHCP service on the Sun Ray server to participate in DTU initialization, a DHCP Relay Agent must be configured on the remote subnet, where it collects DHCP broadcast traffic and forwards it to the Sun Ray server.

Network Configuration Tasks

The addition of directly-connected and remote shared subnet support in Sun Ray Server Software 2.0 allows DTUs to be deployed virtually anywhere on the enterprise intranet, subject only to the provision of DHCP service and a sufficient quality of service between the DTU and the Sun Ray server.

The following sections explain how to configure a network to support these deployment scenarios:

- a directly-connected dedicated interconnect
- a directly-connected shared subnet
- a remote shared subnet

FIGURE 2 shows the overall topology and the configuration tasks discussed in this section.[4]

4. The /24 suffix in IP addresses indicates the use of Classless Inter Domain Routing (CIDR) notation, which is documented in IETF RFCs 1517, 1518, and 1519

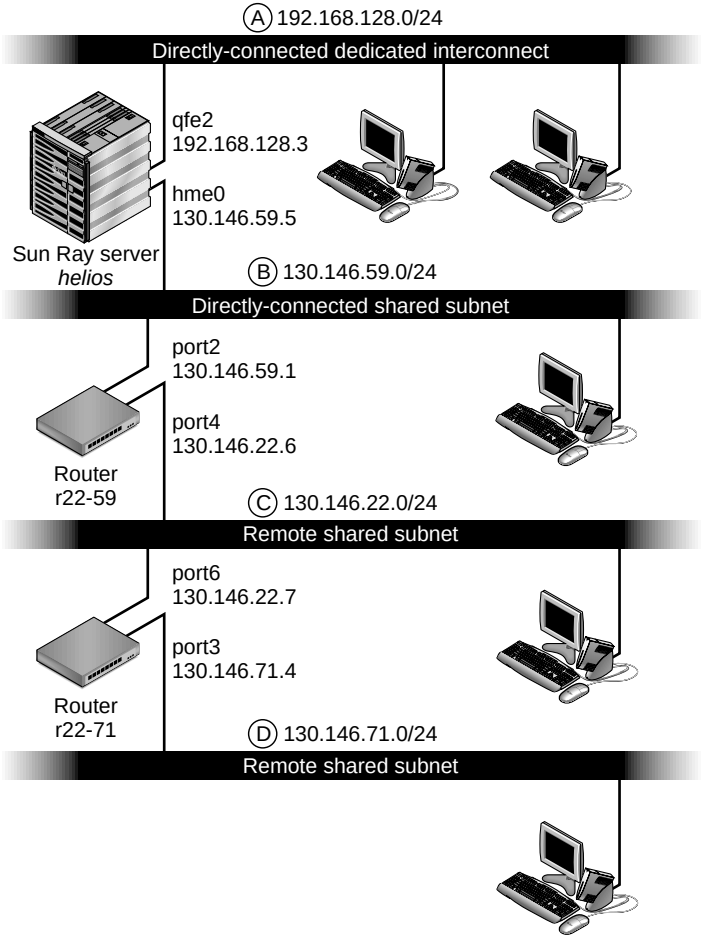

FIGURE 2 Sun Ray Network Topology

Preparing for Deployment

Before deploying a DTU onto any subnet, the administrator must answer three questions:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?
2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?
3. How will DTUs on this subnet locate their Sun Ray server?

The answers to these questions determine what configuration steps will let DTUs placed on this subnet initialize themselves and offer Sun Ray sessions to users.

The following sections present examples of DTU deployment on the directly-connected dedicated interconnect A, the directly-connected shared subnet B, and the remote shared subnets C and D shown in FIGURE 2.

Deployment on a Directly-Connected Dedicated Interconnect

Subnet A in FIGURE 2 is a directly-connected dedicated interconnect. Its subnet will use IP addresses in the range `192.168.128.0/24`. The Sun Ray server named `helios` is attached to the interconnect through its `qfe2` network interface, which will be assigned the IP address `192.168.128.3`.

In an interconnect scenario, the DHCP service on the Sun Ray server always provides both basic networking parameters and additional configuration parameters to the DTU. The answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   On a directly-connected dedicated interconnect, basic networking parameters are always supplied by the DHCP service on the Sun Ray server.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   On a directly-connected dedicated interconnect, additional configuration parameters are always supplied by the DHCP service on the Sun Ray server.

3. How will DTUs on this subnet locate their Sun Ray server?

   On a directly-connected dedicated interconnect, the DTU is always notified of the location of the Sun Ray server through an additional configuration parameter supplied in Step 2.

Directly-Connected Dedicated Interconnect: Example

This is an example of DHCP service for the directly-connected dedicated interconnect A shown in FIGURE 2.

1. **Configure the Sun Ray server to provide both basic and additional parameters to the interconnect.**

   Use the `utadm -a` *ifname* command to configure DHCP service for DTUs on an interconnect. In this example, the interconnect is attached through interface `qfe2`, so the appropriate command is:

```
# /opt/SUNWut/sbin/utadm -a qfe2
### Configuring /etc/nsswitch.conf
### Configuring Service information for Sun Ray
### Disabling Routing
### configuring qfe2 interface at subnet 192.168.128.0
 Selected values for interface "qfe2"
   host address:         192.168.128.1
   net mask:             255.255.255.0
   net address:          192.168.128.0
   host name:            helios-qfe2
   net name:             SunRay-qfe2
   first unit address:   192.168.128.16
   last unit address:    192.168.128.240
   auth server:          192.168.128.1
   firmware server:      192.168.128.1
   router:               192.168.128.1
   alternate servers:
 Accept as is? ([Y]/N): n
 new host address: [192.168.128.1] 192.168.128.3
 new netmask: [255.255.255.0]
 new host name: [helios-qfe2]
 Do you want to offer IP addresses for this interface? ([Y]/N):
 new first Sun Ray address: [192.168.128.16]
 number of Sun Ray addresses to allocate: [239]
 new auth server: [192.168.128.3]
 new firmware server: [192.168.128.3]
 new router: [192.168.128.3]
Specify alternate server list? (Y/[N]):
 Selected values for interface "qfe2"
  host address:          192.168.128.3
  net mask:              255.255.255.0
  net address:           192.168.128.0
  host name:             helios-qfe2
  net name:              SunRay-qfe2
  first unit address:    192.168.128.16
  last unit address:     192.168.128.254
  auth server:           192.168.128.3
  firmware server: 1     192.168.128.3
  router:                192.168.128.3
  alternate servers:
 Accept as is? ([Y]/N):
### successfully set up "/etc/hostname.qfe2" file
### successfully set up "/etc/inet/hosts" file
### successfully set up "/etc/inet/netmasks" file
### successfully set up "/etc/inet/networks" file
### finished install of "qfe2" interface
### Building network tables - this will take a few minutes
```

```
### Configuring firmware version for Sun Ray
        All the units served by "helios" on the 192.168.128.0
        network interface, running firmware other than version
        "2.0_37.b,REV=2002.12.19.07.46" will be upgraded at their
        next power-on.
### Configuring Sun Ray Logging Functions
DHCP is not currently running, should I start it? ([Y]/N):
### started DHCP daemon
#
```

In this example, the default values initially suggested by utadm were not appropriate. (Specifically, the suggested value for the server's IP address on the interconnect was not the desired value.) The administrator replied **n** to the first `Accept as is?` prompt and was given the opportunity to provide alternative values for the various parameters.

2. **Restart Sun Ray services on the Sun Ray server.**

   Once the `utadm` command has completed, issue a `utrestart` command to fully activate Sun Ray services on the newly-defined interconnect:

```
# /opt/SUNWut/sbin/utrestart
Resetting servers... messages will be logged to /var/opt/SUNWut/log/
messages.
```

Deployment on a Directly-Connected Shared Subnet

Subnet B in FIGURE 2 is a directly-connected shared subnet that uses IP addresses in the range `130.146.59.0/24`. The Sun Ray server `helios` is attached to the interconnect through its `hme0` network interface, which has been assigned the IP address `130.146.59.5`. The answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   In a shared subnet scenario, you must choose whether a DHCP service on the Sun Ray server or some external DHCP service will provide the DTU with basic network parameters. If the enterprise already has a DHCP infrastructure that covers this subnet, it probably supplies basic network parameters. If no such infrastructure exists, configure the Sun Ray server to provide basic network parameters.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

The administrator must choose whether to supply additional configuration parameters to the DTU and, if so, whether to use a DHCP service on the Sun Ray server or some external DHCP service for this purpose. On a directly connected shared subnet, it is possible to deploy DTUs without providing additional parameters at all, but since this deprives the DTU of a number of features, including the ability to download new firmware, it is generally undesirable.

Administrators of an already established DHCP infrastructure may be unable or unwilling to reconfigure that infrastructure to provide additional Sun Ray configuration parameters, so it is usually more convenient to have the Sun Ray server provide these parameters. Even when the established infrastructure is capable of delivering the additional parameters, it may be desirable to have the Sun Ray server provide them. This enables SRSS commands to be used to manage the values of the additional configuration parameters when those values need to be changed in response to software upgrades or patch installations on the Sun Ray server. For instance, a patch that delivers new DTU firmware could automatically update the firmware version string that is delivered to the DTU. However, if the firmware version parameter is supplied by some external DHCP service, an administrator must manually edit the firmware version parameter string in the external DHCP configuration rules to reflect the new firmware version delivered by the patch. This activity is time-consuming and error-prone, as well as unnecessary.

3. How will DTUs on this subnet locate their Sun Ray server?

   Use one of the optional additional configuration parameters to report the location of the Sun Ray server to the DTU. If additional configuration parameters are not supplied to the DTU at all, the DTU has no indication of the location of any Sun Ray server. In these circumstances, the DTU attempts to discover the location of a Sun Ray server by using a broadcast-based mechanism. However, the DTUs broadcast packets propagate only on the local subnet, so, in the case of a remote subnet, the broadcast cannot reach the Sun Ray server, and contact cannot be established.

The following examples illustrate two configurations of the directly connected shared subnet. In the first example, the Sun Ray server delivers both basic networking parameters and additional parameters. In the second example, an external DHCP service supplies basic networking parameters, and no additional parameters are provided to the DTU, which must establish contact with the Sun Ray server through its local subnet broadcast discovery mechanism.

The most likely case, where an external DHCP service provides basic networking parameter and the Sun Ray server provides additional parameters, is illustrated by an example in “Deployment on a Remote Subnet.”

Directly-Connected Shared Subnet: Example 1

In this example, the answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   From the Sun Ray server.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   From the Sun Ray server.

3. How will DTUs on this subnet locate their Sun Ray server?

   The DTUs will be informed of the location of the Sun Ray server through an additional configuration parameter delivered in Step 2.

1. Configure the Sun Ray server to provide both basic and additional parameters to the shared subnet.

DHCP service for DTUs on a shared subnet is configured through the `utadm -A` *subnet* command. In this example, the shared subnet has network number `130.146.59.0`, so the appropriate command is `utadm -A 130.146.59.0`:

```
# /opt/SUNWut/sbin/utadm -A 130.146.59.0
  Selected values for subnetwork "130.146.59.0"
    net mask:                  255.255.255.0
    no IP addresses offered
    auth server:               130.146.59.5
    firmware server:           130.146.59.5
    router:                    130.146.59.1
    alternate servers:
  Accept as is? ([Y]/N): n
  netmask: 255.255.255.0 (cannot be changed - system defined netmask)
  Do you want to offer IP addresses for this subnet?  (Y/[N]): y
  new first Sun Ray address: [130.146.59.4]  130.146.59.200
  number of Sun Ray addresses to allocate: [55] 20
  new auth server:           [130.146.59.5]
  new firmware server:       [130.146.59.5]
  new router:                [130.146.59.1]
Specify alternate server list? (Y/[N]):
  Selected values for subnetwork "130.146.59.0"
    net mask:                130.146.59.0
    first unit address:      130.146.59.200
    last unit address:       130.146.59.219
    auth server:             130.146.59.5
    firmware server:         130.146.59.5
    router:                  130.146.59.1
    alternate servers:
 Accept as is? ([Y]/N):
### Building network tables - this will take a few minutes
```

```
### Configuring firmware version for Sun Ray
    All the units served by "helios" on the 130.146.59.0
    network interface, running firmware other than version
    "2.0_37.b,REV=2002.12.19.07.46" will be upgraded at
    their next power-on.
### Configuring Sun Ray Logging Functions
### stopped DHCP daemon
### started DHCP daemon
#
```

The default values initially suggested by utadm were not appropriate. Specifically, this server would not have offered any IP addresses on the `130.146.59.0` subnet because utadm assumes that basic networking parameters, including IP addresses, are provided by some external DHCP service when the DTU is located on a shared subnet. In this example, however, the Sun Ray server is required to provide IP addresses, so the administrator replied **`n`** to the first `Accept as is?` prompt and was given the opportunity to provide alternative values for the various parameters. Twenty IP addresses, starting at `130.146.59.200`, were made available for allocation to DHCP clients on this subnet.

2. **Restart Sun Ray services on the Sun Ray server.**

   Once the `utadm` command has completed, issue a `utrestart` command to fully activate Sun Ray services on the shared subnet:

```
# /opt/SUNWut/sbin/utrestart
Resetting servers... messages will be logged to /var/opt/SUNWut/log/messages.
```

Directly-Connected Shared Subnet: Example 2

In this example, the answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   From an external DHCP service.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   The DTUs will not be supplied with additional parameters.

3. How will DTUs on this subnet locate their Sun Ray server?

   By using the local subnet broadcast discovery mechanism.

In this example, the Sun Ray server does not participate in DTU initialization at all. Why, then, are configuration steps required on the Sun Ray server? The Sun Ray server responds by default only to DTUs located on directly connected dedicated interconnects. It responds to DTUs on shared subnets only if the `utadm -L on`

command has been executed. Running the `utadm -A` *subnet* command to activate DHCP on the Sun Ray server for a shared subnet, as in this example, implicitly executes `utadm -L on`. If `utadm -A` *subnet* has not been run, the administrator must run `utadm -L on` manually to allow the server to offer sessions to DTUs on the shared subnet.

1. **Configure the external DHCP service.**

   Determining how to configure the external DHCP infrastructure to provide basic networking parameters to the DTUs on this subnet is beyond the scope of this document. Bear in mind:

   - If the external DHCP service does not have its own direct connection to this subnet, the administrator must configure a DHCP Relay Agent to deliver DHCP traffic on this subnet to the external DHCP service. The most likely location for such a Relay Agent would be on a router in this subnet, in this case the router named `r22-59` in FIGURE 2. For a brief introduction to this topic refer to “DHCP Relay Agent” on page 4.
   - An existing external DHCP service may need to have its IP address allocation for this subnet increased in order to support the new DTUs. (This applies whenever additional DHCP clients are placed on a subnet.) It might also be desirable to reduce the lease time of addresses on this subnet so that addresses become eligible for reuse quickly.

2. **Configure the Sun Ray server to accept DTU connections from shared subnets.**

   Run `utadm -L on`:

```
# /opt/SUNWut/sbin/utadm -L on
### Turning on Sun Ray LAN connection
NOTE: utrestart must be run before LAN connections will be allowed
```

3. **Restart Sun Ray services on the Sun Ray server.**

   Once the `utadm` command has completed, issue a `utrestart` command to fully activate Sun Ray services on the shared subnet:

```
# /opt/SUNWut/sbin/utrestart
Resetting servers... messages will be logged to
/var/opt/SUNWut/log/messages.
```

Deployment on a Remote Subnet

Subnets C and D in FIGURE 2 are remote shared subnets.

Subnet C uses IP addresses in the range `130.146.22.0/24`. Subnet D uses IP addresses in the range `130.146.71.0/24`. The Sun Ray server named `helios` has no direct attachment to either of these subnets; it is this characteristic that defines them as remote. The answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   In a shared subnet scenario, the administrator must choose whether a DHCP service on the Sun Ray server or some external DHCP service will provide the DTU with basic network parameters.

   If the enterprise already has a DHCP infrastructure that covers this subnet, it probably supplies basic network parameters. If no such infrastructure exists, configure the Sun Ray server to provide basic network parameters.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   The administrator must choose whether additional configuration parameters will be supplied to the DTU, and if so whether they will be supplied by a DHCP service on the Sun Ray server or by some external DHCP service.

   Administrators of an established DHCP infrastructure may be unable or unwilling to reconfigure it to provide additional Sun Ray configuration parameters, so it is usually more convenient to have the Sun Ray server provide them.

   Even when the established infrastructure is capable of delivering the additional parameters, it may be desirable to have the Sun Ray server provide them. This enables you to use Sun Ray Server Software commands to manage the values of the additional configuration parameters, when those values need to be changed in response to software upgrades or patch installations on the Sun Ray server. For instance, a patch that delivers new DTU firmware could automatically update the firmware version string delivered to the DTU. However, if the firmware version parameter is supplied by some external DHCP service, an administrator must manually edit the firmware version parameter string in the external DHCP configuration rules to reflect the new firmware version delivered by the patch. This kind of activity is time-consuming and error-prone as well as unnecessary.

3. How will DTUs on this subnet locate their Sun Ray server?

   Use one of the optional additional configuration parameters to report the location of the Sun Ray server to the DTU. If additional configuration parameters are not supplied to the DTU at all, the DTU cannot locate a Sun Ray server, so it tries to discover the location of a Sun Ray server by using a broadcast-based mechanism. However, the DTUs broadcast packets propagate only on the local subnet; they cannot reach a Sun Ray server located on a remote subnet, and cannot establish contact.

The next two examples illustrate representative remote shared subnet configurations. In the first example, an external DHCP service provides basic networking parameters, and the Sun Ray server provides additional parameters. This is by far the most likely configuration for a Sun Ray deployment in an enterprise that has an established DHCP infrastructure.

In the second example, basic networking parameters and a bare minimum of additional parameters—just enough to enable the DTU to contact a Sun Ray server—are supplied by an external DHCP. In this case, it is the DHCP service in a Cisco router. This scenario is less than ideal.

No firmware parameters are delivered to the DTU, so it cannot download new firmware. The administrator must make some other arrangement to provide the DTU with new firmware, for instance, by rotating it off this subnet periodically onto an interconnect or onto some other shared subnet where a full set of additional configuration parameters is offered.

Note – For examples of shared subnet deployments in which both basic networking parameters and additional parameters are delivered by the Sun Ray server and basic networking parameters are supplied by an external DHCP service (with no additional DTU parameters provided), see ”Directly-Connected Shared Subnet” on page 6.

Remote Shared Subnet: Example 1

In this example, in which DTUs are deployed on subnet C in FIGURE 2, the answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   From an external DHCP service.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   From the Sun Ray server.

3. How will DTUs on this subnet locate their Sun Ray server?

   The DTUs will be informed of the location of the Sun Ray server through an additional configuration parameter delivered in Step 2.

   Use the `utadm -A` *subnet* command as follows to configure DHCP service for DTUs on a shared subnet.

1. **Configure the External DHCP Service.**

   Determining how to configure the external DHCP infrastructure to provide basic networking parameters to the DTUs on this subnet is beyond the scope of this document. Bear in mind:

   - If the external DHCP service does not have its own direct connection to this subnet, the administrator must configure a DHCP Relay Agent to deliver DHCP traffic on this subnet to the external DHCP service. The most likely location for such a Relay Agent would be on a router in this subnet, in this case the router named `r22-59` in FIGURE 2. For a brief introduction to this topic refer to "DHCP Relay Agent" on page 4.
   - An existing external DHCP service may need to have its IP address allocation increased for this subnet to support the new DTUs. (This applies whenever additional DHCP clients are placed on a subnet.) It might also be desirable to reduce the lease time of addresses on this subnet so that addresses become eligible for re-use quickly.

2. **Arrange to Deliver DHCP Traffic to the Sun Ray Server.**

   Because the Sun Ray server does not have its own direct connection to this subnet, the administrator must configure a DHCP Relay Agent to deliver the subnet's DHCP traffic to the Sun Ray server. The most likely location for such a Relay Agent would be on a router in this subnet, in this case the router named `r22-59` in FIGURE 2. For a brief introduction to this topic refer to "DHCP Relay Agent" on page 4.

   If `r22-59` is running the Cisco IOS, the `ip helper-address command` can be used to activate its DHCP Relay Agent to relay DHCP broadcasts from its 10/100 Ethernet port number 4 to the Sun Ray server at `130.146.59.5`.

```
r22-59> interface fastethernet 4
r22-59> ip helper-address 130.146.59.5
r22-59>
```

   If the external DHCP service also lacks a connection to this subnet, configure a DHCP Relay Agent to forward requests from the DTU to:

   - The external DHCP service (so that the DTU can obtain basic networking parameters)
   - The DHCP service on the Sun Ray server (so that the DTU can obtain additional parameters)

   The Cisco IOS `ip helper-address` command accepts multiple relay destination addresses, so if, for instance, the external DHCP service could be contacted at `130.146.59.2` on subnet B in FIGURE 2, the appropriate sequence would be:

```
r22-59> interface fastethernet 4
r22-59> ip helper-address 130.146.59.2 130.146.59.5
r22-59>
```

Note – Details of the IOS interaction vary according to the specific release of IOS, the model of the router, and the hardware installed in the router.

3. **Configure the Sun Ray server to provide additional parameters to the shared subnet.**

   Use the `utadm -A` *subnet* command to configure DHCP service for DTUs on a shared subnet. In this example, the shared subnet has network number `130.146.22.0`, so the appropriate command is `utadm -A 130.146.22.0`.

```
# /opt/SUNWut/sbin/utadm -A 130.146.22.0
  Selected values for subnetwork "130.146.22.0"
    net mask:              255.255.255.0
    no IP addresses offered
    auth server:           130.146.59.5
    firmware server:       130.146.59.5
    router:                130.146.22.1
    alternate servers:
Accept as is? ([Y]/N): n
new netmask:[255.255.255.0]
Do you want to offer IP addresses for this subnet? (Y/[N]):
new auth server:[130.146.59.5]
new firmware server:[130.146.59.5]
new router: [130.146.22.1] 130.146.22.6
Specify alternate server list? (Y/[N]):
Selected values for subnetwork "130.146.59.0"
    net mask:              255.255.255.0
    no IP addresses offered
    auth server:           130.146.59.5
    firmware server:       130.146.59.5
    router:                130.146.22.6
    alternate servers:
Accept as is? ([Y]/N):
### Building network tables - this will take a few minutes
### Configuring firmware version for Sun Ray
All the units served by "helios" on the 130.146.22.0
network interface, running firmware other than version
"2.0_37.b,REV=2002.12.19.07.46" will be upgraded at their
next power-on.
### Configuring Sun Ray Logging Functions
### stopped DHCP daemon
### started DHCP daemon
#
```

In this example, the default values initially suggested by `utadm` were not appropriate. Specifically, the default router address to be used by DTUs on this subnet was not correct because `utadm` guesses that the address of the default router for any shared subnet will have a host part equal to 1. This was a *great* guess for the directly-connected subnet B in FIGURE 2, but it is not correct for subnet C.

The appropriate router address for DTUs on this subnet is `130.146.22.6` (port 4 of router `r22-59`), so the administrator replied **`n`** to the first `Accept as is?` prompt and was given the opportunity to provide alternative values for the various parameters.

4. **Restart Sun Ray services on the Sun Ray server.**

   Once the `utadm` command has completed, issue a `utrestart` command to fully activate Sun Ray services on the shared subnet:

```
# /opt/SUNWut/sbin/utrestart
Resetting servers... messages will be logged to
/var/opt/SUNWut/log/messages.
```

Remote Shared Subnet: Example 2

In this example, deploying DTUs on subnet D in FIGURE 2, the answers to the three pre-deployment questions are:

1. From which DHCP server will DTUs on this subnet get their basic IP networking parameters?

   From an external DHCP service.

2. From which DHCP server will DTUs on this subnet get additional configuration parameters to support features such as firmware download?

   The DTUs will not be supplied with the additional parameters required to support firmware download or to activate other advanced DTU features.

3. How will DTUs on this subnet locate their Sun Ray server?

   The external DHCP service will supply a single additional parameter to inform the DTU of the location of a Sun Ray server.

In this example, the Sun Ray server does not participate in DTU initialization at all. Why, then, are configuration steps required on the Sun Ray server? The Sun Ray server responds by default only to DTUs located on directly connected dedicated interconnects. It responds to DTUs on shared subnets only if the `utadm -L on` command has been executed. Running the `utadm -A` *subnet* command to activate DHCP on the Sun Ray server for a shared subnet, as in this example, implicitly executes `utadm -L on`. If `utadm -A` *subnet* has not been run, the administrator must run `utadm -L on` manually to allow the server to offer sessions to DTUs on the shared subnet.

1. **Configure the External DHCP Service.**

   Determining how to configure the external DHCP infrastructure to provide basic networking parameters to the DTUs on this subnet is beyond the scope of this document. However, for this example, assume that DHCP service is provided by Cisco IOS-based router `r22-71` in FIGURE 2, attached to the `130.146.71.0` subnet through its 10/100 Ethernet port 3. This router can be configured to provide basic networking parameters and the location of a Sun Ray server as follows:

```
r22-71> interface fastethernet 3
r22-71> ip dhcp excluded-address 130.146.71.1 130.146.71.15
r22-71> ip dhcp pool CLIENT
r22-71/dhcp> import all
r22-71/dhcp> network 130.146.71.0 255.255.255.0
r22-71/dhcp> default-router 130.146.71.4
r22-71/dhcp> option 49 ip 130.146.59.5
r22-71/dhcp> lease 0 2
r22-71/dhcp> ^Z
r22-71>
```

Note – Details of the IOS interaction vary according to the specific release of IOS, the model of router and the hardware installed in the router.

DHCP option 49, the standard option of the *X Window Display Manager*, identifies `130.146.59.5` as the address of a Sun Ray server. In the absence of `AltAuth` and `Auth-Srvr` vendor-specific options, the DTU tries to find a Sun Ray server by broadcasting on the local subnet. If the broadcasts evoke no response, the DTU uses the address supplied in t option of the *X Window Display Manager*—provided that the DTU contains firmware at Sun Ray Server Software 2.0 patch level 114880-01 or greater.

Note – This is an unorthodox use of the option of the X Window Display Manager, but in a remote subnet deployment where vendor-specific options can not be delivered, it may be the only way of putting a DTU in touch with a server.

---

2. **Configure the Sun Ray server to accept DTU connections from shared subnets by running** `utadm -L on`**.**

```
# /opt/SUNWut/sbin/utadm -L on
### Turning on Sun Ray LAN connection
NOTE: utrestart must be run before LAN connections will be allowed
#
```

3. **Restart Sun Ray services on the Sun Ray server.**

   Once the utadm command has completed, issue a `utrestart` command to fully activate Sun Ray services on the shared subnet:

```
# /opt/SUNWut/sbin/utrestart
Resetting servers... messages will be logged to /var/opt/SUNWut/log/
messages.
#
```

TABLE 2 lists the vendor-specific DHCP options that Sun Ray defines and uses.

TABLE 2 Vendor-specific DHCP Options

Parameter Name	Client Class	Option Code	Data Type	Optional/ Mandatory	Granularity	Max Count	Comments
AltAuth	SUNW.NewT.SUNW	35	IP	Optional	1	0	List of Sun Ray server IP addresses
AuthSrvr	SUNW.NewT.SUNW	21	IP	Mandatory	1	1	Single Sun Ray server IP addresses
AuthPort	SUNW.NewT.SUNW	22	NUMBER	Optional	2	1	Sun Ray server port
NewTVer	SUNW.NewT.SUNW	23	ASCII	Optional	1	0	Desired firmware version
FWSrvr	SUNW.NewT.SUNW	31	IP	Optional	1	1	Firmware TFTP server IP address
BarrierLevel	SUNW.NewT.SUNW	36	NUMBER	Mandatory	4	1	Firmware Download: barrier level
LogHost	SUNW.NewT.SUNW	24	IP	Optional	1	1	Syslog server IP address
LogKern	SUNW.NewT.SUNW	25	NUMBER	Optional	1	1	Log level for kernel
LogNet	SUNW.NewT.SUNW	26	NUMBER	Optional	1	1	Log level for network
LogUSB	SUNW.NewT.SUNW	27	NUMBER	Optional	1	1	Log level for USB
LogVid	SUNW.NewT.SUNW	28	NUMBER	Optional	1	1	Log level for video
LogAppl	SUNW.NewT.SUNW	28	NUMBER	Optional	1	1	Sun Rat server interface name
Intf	SUNW.NewT.SUN	29	ASCII	Optional	1	0	Sun Ray server interface name
NewTBW		30	NUMBER	Optional	4	1	Bandwidth cap
NewTDispIndx	SUNW.NewT.SUNW	32	NUMBER	Optional	4	1	Obsolete. Do not use.
NewTFlags	SUNW.NewT.SUNW	34	NUMBER	Optional	4	1	Obsolete. Do not use.

The DTU can perform its basic functions even if none of these options are delivered during initialization, but some advanced DTU features do not become active unless certain options are delivered to the DTU. In particular:

- `AltAuth` and `AuthSrvr` indicate the IP addresses of Sun Ray servers. Addresses in the `AltAuth` list are tried in order until a connection is established. Current firmware ignores `AuthSrvr` if `AltAuth` is provided, but it is good practice always to specify `AuthSrvr` for the benefit of old (pre Sun Ray Server Software 1.3) firmware, which does not understand the `AltAuth` option. If neither of these options is supplied, the DTU tries to locate a Sun Ray server by sending broadcasts on the local subnet. If the DTU contains firmware at Sun Ray Server Software 2.0 patch level 114880-01 or greater, it resorts to trying to contact a Sun Ray server at the address supplied in the option of the `X Window Display Manager` if that option has been provided.
- `NewTVer` and `FWSrvr` must both be provided in order for the DTU to attempt a firmware download. `NewTVer` contains the name of the firmware version that the DTU should use. If this name does not match the name of the firmware version that the DTU is actually running, the DTU tries to download the desired firmware from a TFTP server at the address given by `FWSrvr`.
- `LogHost` must be specified in order for the DTU to report messages through the syslog protocol. Reporting thresholds for major DTU subsystems are controlled by the `LogKern`, `LogNet`, `LogUSB`, `LogVid`, and `LogAppl` options.

Note – The message formats, contents, and thresholds are intended for use only by service personnel and are not documented intentionally.

The DHCP Client Class name for all Sun Ray vendor-specific options is `SUNW.NewT.SUNW`. The DTU cites this name in DHCP requests so that the server can respond with the appropriate set of vendor-specific options. This mechanism guarantees that the DTU is not given vendor options defined for some other type of equipment and that other equipment is not given options that are meaningful only to the DTU.

Network Performance Requirements

This section describes the minimal network infrastructure needed to support a Sun Ray implementation.

Packet Loss

Before version 2.0, Sun Ray Server Software was intolerant of packet losses, so it was recommended that packet loss not exceed 0.1 percent over any extended period. However, because this is often an impractical requirement in local area (LAN) and wide area (WAN) network Sun Ray deployments, the Sun Ray Server Software has been made much more robust in the face of packet loss. The first version of this improved software was released with the first 2.0 patch, with additional improvements in releases supporting low-bandwidth WAN Sun Ray deployments.

In earlier versions, the server tried to avoid packet loss by severely limiting its use of available bandwidth whenever it encountered packet loss. Because random losses are inevitable in a non-dedicated LAN or WAN network environment, this approach put unnecessary limits on performance.

Sun Ray Server Software has always had the capability to detect and recover quickly from such losses, so avoiding them was a matter of policy more than necessity. The new software is less timid and avoids operating at bandwidth levels that create packet losses. Instead, it tries to send data at the highest possible rate that it can without incurring large losses. By design, it sometimes sends data at a rate that is too great for the capacity of the connection between the server and the client, and thus discovers what that capacity is. With very high demand, sustained packet losses of up to 10 percent may sometimes be seen, but the software continues to operate and update the contents of the screen correctly nevertheless.

Latency

Network latency between any Sun Ray client and its server is an important determinant of the quality of the user experience. The lower the latency, the better; latencies under 50 milliseconds for round trip delay are preferred. However, like familiar network protocols such as TCP, the Sun Ray DTU does tolerate higher latencies, but with degraded performance. Latencies up to 150 milliseconds provide usable, if somewhat sluggish, performance.

Out-of-Order Packets

DTUs that contain Sun Ray Server Software 2.0 firmware can tolerate small occurrences of out-of-order packet delivery, such as might be experienced on an Internet or wide-area intranet connection. Sun Ray 2.0 firmware maintains a reordering queue that restores the correct order to packets when they are received out of order. In releases prior to Sun Ray Server Software 2.0, out-of-order packets were simply discarded.

Troubleshooting Tools

`utcapture`

The `utcapture` utility connects to the Sun Ray Authentication Manager and reports packet loss statistics and round-trip latency timings for each DTU connected to this server. See the `utcapture` man page to learn more about this command.

`utquery`

The `utquery` command interrogates a DTU and displays the DTUs initialization parameters along with the IP addresses of the DHCP services that supplied those parameters. It can be helpful in determining whether a DTU was able to obtain the parameters that were expected in a particular deployment and in determining specific DHCP servers that contributed to the DTUs initialization. See the `utquery` man page to learn more about this command.

OSD Icons

Sun Ray DTU on-screen display (OSD) icons contain information that can help the administrator understand and debug network configuration problems. The amount of information encoded into the icons has been significantly expanded in the firmware delivered with Sun Ray Server Software 2.0. The icon structure and progression are described in detail in the troubleshooting section of the *Sun Ray Server Software 2.0 Administrator's Guide.*

About the Authors

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Mike Oliver is a Senior Staff Engineer in the Sun Ray engineering group with over 20 years of professional experience in software and hardware development. Mike has led projects and managed groups working on a wide variety of data communications products and systems. He holds a B.Sc. in Electrical and Electronic Engineering from the University of Bristol (U.K.) and is a member of the IEEE Computer Society and the ACM.

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Raja Doraisamy is a Member of Technical Staff in the Sun Ray engineering group. Having previously contributed to networking products such as Sun Trunking and TCP/IP for Sun Ray, he played a leading role in implementing Sun Ray systems on a shared network infrastructure and has filed two patent disclosures in connection with this work. Raja holds B.S. in computer science from Bharathiar University, India.

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Bob Doolittle is a Senior Staff Engineer in the Sun Ray engineering group. He is a software developer and architect with 27 years of highly varied networking experience, ranging from network administration to porting TCP/IP to massively-parallel supercomputers. Bob has been a member of the Sun Ray team since 1999. He has a B.A. in Information Science from the University of California at Santa Cruz.

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Kent Peacock, Senior Staff Engineer, has been a member of the Sun Ray team since fall of 1998, when the prototype was brought out of Sun Labs for productization. During that time, he has designed and implemented a number of components of the Sun Ray product, including secure firmware signing, the high availability and redundant server failover mechanism, and the encryption and authentication architecture. Most recently, he worked on improvements to allow the Sun Ray to operate over low bandwidth network connections, in support of the “Sun Ray at Home” initiative.

Gerard Wall

Recognized for his work in the areas of networking, graphics and embedded systems, Gerard Wall has made contributions to building computer graphic workstations, image processing, digital publishing systems, and embedded sensor systems over the course of his career. As a researcher in Sun Microsystems Laboratories, he was a member of the High Resolution Video Workstation project and the Time Critical Media Group and was also a key member of the NewT team that invented the basis for the Sun Ray product. Currently a Senior Staff Engineer, he received an M.S. in Computer Science at the University of Illinois at Urbana-Champaign.

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With over 100 technical publication credits since 1985, Gary Sloane has contributed to leading edge projects at Xerox PARC and Silicon Graphics as well as Sun Microsystems. Currently responsible for all Sun Ray engineering publications, he attended Antioch College, Harvard University, the State University of New York at Stony Brook, and the University of California, Irvine.

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